

Carbon Markets

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Markets Why and What

GHG Motivation

CO2 in Atmosphere has grown from 335 to 396 since 1985

With other gasses we are over 420

Pace of climate change accelerating

People argue that past 350 is dangerous

CO2, Methane, Nitrous Oxide

GHG shares

84% of US CO2 emissions are from energy

42% coal fired electricity

42% petroleum

Ag Shares

6% of CO2

50% of methane

70% of Nitrous Oxide

Emissions reduction burden on energy , Ag will play role if
cheaper

Intergovernmental Panel on Climate Change. IPCC Fourth Assessment Report: Working Group III Report "Mitigation of Climate Change" <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>

Current Prospects for Sale

International - Kyoto

Carbon Exchanges in Europe \$13 per tonne CO₂ (was \$40)

Proposed/emerge Canada, New Zealand, Australia

Domestic

No National Emissions limit

Mostly Voluntary Programs -- Niche Markets

CCX price \$2 /ton CO₂

Some state programs

Oregon CO₂ Emissions Standards now

Regional Greenhouse Gas Initiative (RGGI) now

California Global Warming Solutions Act

The Western Climate Initiative (WCI) - 2010

Bills being introduced

Can't sell ag for money today except in a niche

Why is CCX working and soil

Firms with assets at risk

30% cutback frightening to a power plant

Advertizing

Green desires

The Chicago Climate Exchange (CCX)

Ag soil

Size 10,000 tonnes - group of farms

½ ton CO₂ per acre so 20,000 acres

commitment 5 yrs min till – no history

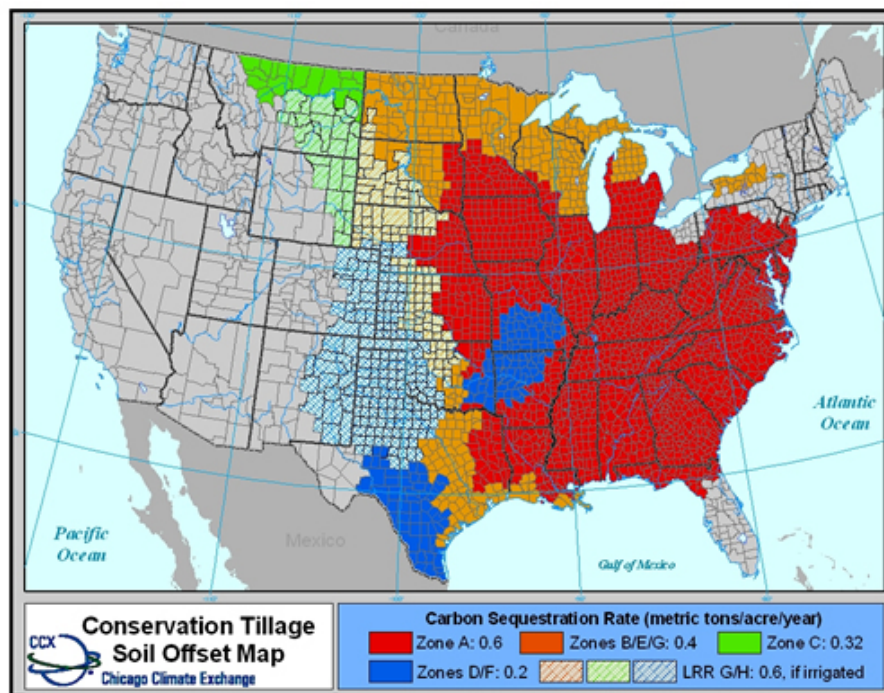
Farms must have at least 250 acres

Will be inspected

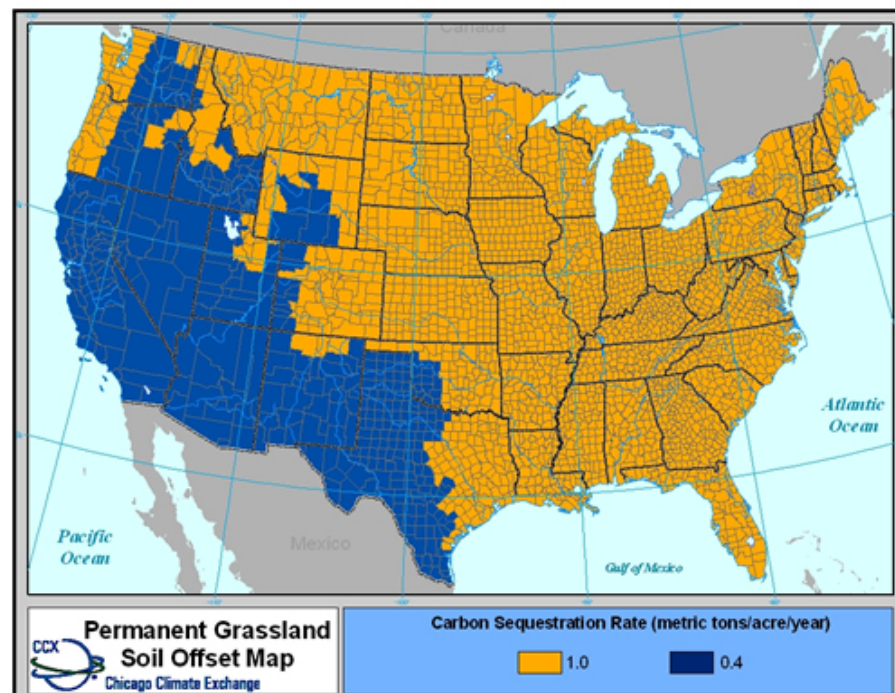
Price ~\$2 per acre but market is thin

Ribera, L.A.L., J. Zenteno, and B.A. McCarl, "Carbon Sequestration: a Potential Source of Income for Farmers", Journal of the American Society of Farm Managers and Rural Appraisers, forthcoming, 2009. <http://www.afpc.tamu.edu/pubs/2/519/RR%2008-03.pdf>

CCX Agricultural Soil Sequestration Map



Conservation tillage soil offset map

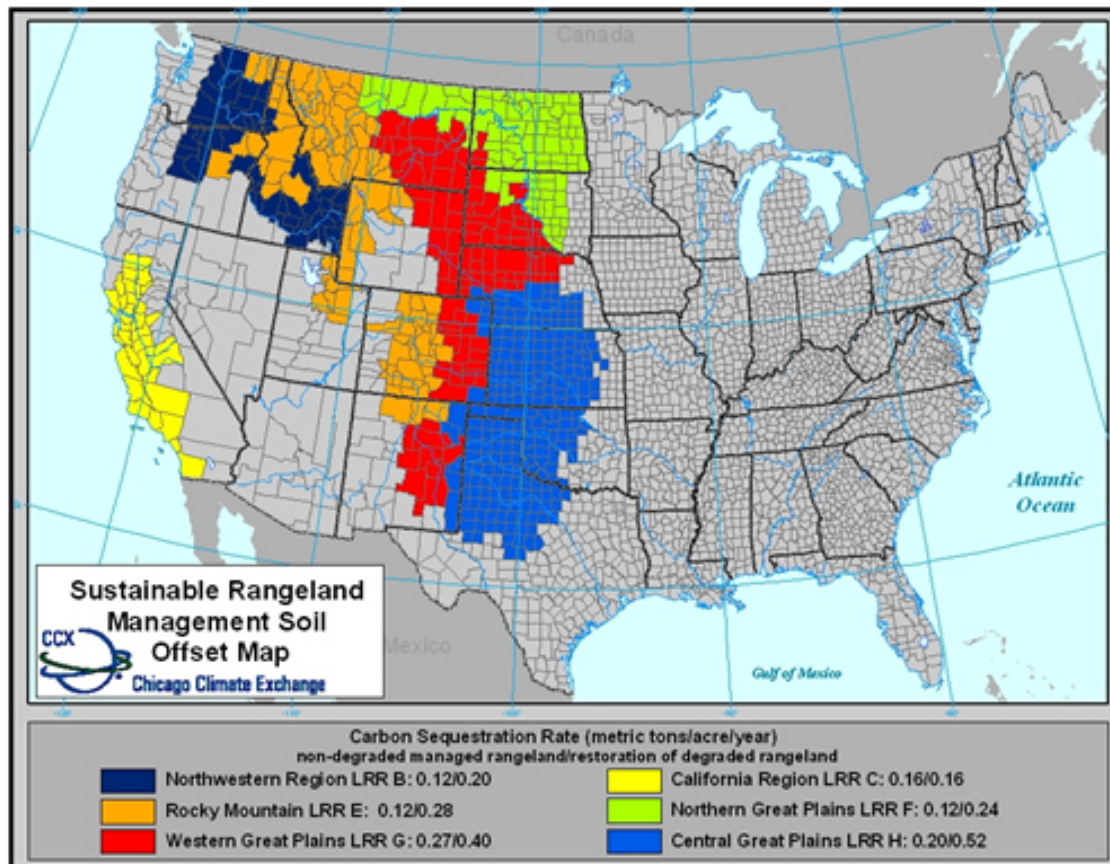


Permanent grassland soil offset map

Unit is metric tons of CO₂/acre/year

Source: CCX (2007)

CCX Rangeland Soil Carbon Sequestration Map



Grey areas are not qualified for CCX rangeland soil carbon sequestration

Source: CCX (2007)

Future Prospects for Sale

Need an emissions cap or a government program

Many bills

US into Kyoto later? Takes 20+ Kyoto's to stabilize at 550 ppm compared to today 390 ppm

Likely to go into some form of carbon market given inevitability of high future atmospheric concentrations and associated climate change

What Might Agriculture Sell

Sequestration

- Soil tillage changes
- Grassland conversions (to grass)
- Afforestation

Methane (24 CO₂ price)

- Manure lagoon
- Rice
- Animal enteric fermentation numbers

Nitrous Oxide (296 CO₂ price)

- Fertilizer
- Manure
- Legumes

Biofuels (probably not direct)

McCarl, B.A. and U.A. Schneider, **U.S. Agriculture's Role in a Greenhouse Gas Emission Mitigation World: An Economic Perspective**, *Review of Agricultural Economics* 22 (Spring/ Summer 2000):134-59

<http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/669.pdf>

Murray, B.C., A.J. Sommer, B. Depro, B.L. Sohngen, B.A. McCarl, D. Gillig, B. de Angelo, and K. Andrasko, **Greenhouse Gas Mitigation Potential in US Forestry and Agriculture**, EPA Report 430-R-05-006, November, 2005.

http://www.epa.gov/sequestration/greenhouse_gas.html

Avoid it – Ag and Forest

Agricultural/Forestry/Biofuel Mitigation Possibilities

Strategy	Basic Nature	CO2	CH4	N2O
Crop Mix Alteration	Emis, Seq	X		X
Crop Fertilization Alteration	Emis, Seq	X		X
Crop Input Alteration	Emission	X		X
Crop Tillage Alteration	Emission	X		X
Grassland Conversion	Sequestration	X		
Irrigated /Dry land Mix	Emission	X		X
Biofuel Production	Offset	X	X	X
Stocker/Feedlot mix	Emission	X		
Enteric fermentation	Emission	X		
Livestock Herd Size	Emission	X	X	
Livestock System Change	Emission	X	X	
Manure Management	Emission	X	X	
Rice Acreage	Emission	X	X	X
Afforestation (not today)	Sequestration	X		
Existing timberland Management	Sequestration	X		
Deforestation	Emission	X		

Murray, B.C., A.J. Sommer, B. Depro, B.L. Sohngen, B.A. McCarl, D. Gillig, B. de Angelo, and K. Andrasko, Greenhouse Gas Mitigation Potential in US Forestry and Agriculture, EPA Report 430-R-05-006, November, 2005. <http://www.epa.gov/sequestration/pdf/greenhousegas2005.pdf>
 McCarl, B.A., and U.A. Schneider, "The Cost of Greenhouse Gas Mitigation in US Agriculture and Forestry," Science, Volume 294 (21 Dec), 2481-2482, 2001.

Will Agriculture Get Full Price

No because of

Transactions Cost

Potential Kyoto Features

Additionality

Uncertainty

Permanence

Leakage

McCarl, B.A., Butt, T.A., and Kim, M. How much would carbon cost a buyer? College Station, TX: Texas A&M University Department of Agricultural Economics. Available on the World Wide Web: <http://agecon.tamu.edu/faculty/mccarl/1015.pdf>.

Transactions Cost

Carbon must be marketed and cost arises

Assembly Costs

Emitting entities emit large quantities of GHGs.

It not economically efficient for a purchaser in quest of
100,000 tons to deal with a single farmer.

100,000 tonnes at 0.25 tons per acre = 400,000 acres

400 acres/farm => 1,000 farmers (avg U.S. is 460 acres)

This implies role for brokers who aggregate producers
and sell permits. Cost arises in such process.

Measurement, and monitoring

Certification

Enforcement

Additional adoption cost incentive estimates

Management (insurance or reserve) of adverse outcomes

McCarl, B.A., J.M. Antle and B.C. Murray, "Agricultural Soil Carbon Sequestration-Economic Issues and Research Needs", 2001.

<http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/0875.pdf>

Permanence

Carbon is sequestered in a volatile form.

Once stored can be released by soil disturbance, changed tillage, fires (above ground portion only).

Payments for practice maintenance may be needed.

Farm groups in Canada have advocated leasing

Saturation also an issue

Market may discount for these characteristics as opposed to permanent emissions offsets

Additionality and Uncertainty

Additionality - Activities only receive credit if they would not otherwise have been done. Thus if land has or would have adopted no-till a project involving such **should receive a discount**. Only **additional** GHG offset is to be paid for.

Uncertainty - Agriculture and forestry are characterized by pervasive yield uncertainty. Volume of GHG offsets will vary with weather and unforeseen events. The issue then: **What level of offset could be "confidently" counted on to occur?** Approaches have been suggested. Canada during KP negotiations suggested one be paid for a lower confidence interval (90% certain amount) not the average amount.

McCarl, B.A., Permanence, Leakage, Uncertainty and Additionality in GHG Projects

<http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/1149.pdf>

Leakage

GHG offsets can be undermined if leakage or slippage occurs. Actions to reduce net emissions may alter current or anticipated production levels, in turn creating competitive responses that can induce emission increases elsewhere. (e.g.) Cutting down Brazilian rainforest)

Consider changes in PNW tree harvest that occurred. They reduced harvest by 90% in a 10 year program on public lands. It has been computed that PNW/South/Canada harvest replaced 86% so net gain only 14%

Actions may be subject to a leakage discount

McCarl, B.A., Permanence, Leakage, Uncertainty and Additionality in GHG Projects

<http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/1149.pdf>

Barriers

Carbon trading by agriculture will not happen unless allowed by trading rules or legislation

After 10 years of discussion and advocacy **soils** not allowed in Kyoto based trading systems, **manure methane is**, **no fertilizer I don't think rice or enteric forests are**

Many of the congressional bills disallow agriculture

Kim, Man-Keun and Bruce A., McCarl. "Carbon Sequestration and Its Trading." Presented at the Symposium on Measures to Climatic Change in the Agricultural Sector, Rural Development Administration (RDA), (Korea) National Institute of Agricultural Science and Technology (NIAST) Seoul, Korea (September 2008)

Risk of Sale

Lien on property - Property rights an issue once you sell what happens if change land use, will they need emission permits to fertilize, feed, change tillage?

May make money tomorrow but costs will also come

Risk of being an early actor - May get caught by additionality if before grandfathering date

Obsolescence of essential treatments – Roundup Resistance

Alternative to Markets

Biofuel programs

Advanced biofuels under energy act requires
a given level of GHG offset

Bruce A. McCarl Will Bioenergy be Profitable: Markets, Lifecycle Carbon Footprint, Commodity
Prices and Leakage http://www.growok.com/slides/McCarl-Will_Bioenergy_be_Profitable.pdf

Conventional NRCS Programs

Concluding comments

Markets may exist but are thin

Need a cap plus rules that accommodate ag

Prices low as is profitability at current time

Prices may be discounted

Risks of early or eventual action

Biofuels under energy act may be here first